DOCUMENT RESUME

ED 219 252 SE 038 754

TITLE Physics Curriculum Development Project. Aims, Organisation, Activities of PLON: A Physics Curriculum Development Project for General Secondary Education in the Netherlands. Outline.
INSTITUTION Utrecht State Univ., The Netherlands.
PUB DATE Mar 82
NOTE 14p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Curriculum Development; Curriculum Evaluation; Foreign Countries; Instructional Improvement; *Physics; *Science Curriculum; Science Education; *Science Instruction; Secondary Education; *Secondary School Science
IDENTIFIERS *Netherlands; *Physics Curriculum Development Project

ABSTRACT

This document highlights the aims and activities of a project designed to modernize and update physics teaching and physics curriculum in the Netherlands by developing materials for use with students aged 12-18 at intermediate general, higher general, and pre-university schools. Following general information (including a brief description of the education system in the Netherlands, project staff, project organization, and finance), the educational aims of the project, curriculum development (including developmental strategy, present state, and future plans), teacher training and participation, research/evaluation, and dissemination/innovation are briefly discussed. The aims of the project focus on producing materials that are meaningful to students, link physics to every-day lives of students, focus on relationship between physics and society, provide for individual differences, and focus on the ways students solve problems. A list of commercially available materials (written in Dutch) and those still under development is provided. (JN)

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1. general information

1.1 name of the project

The name of the project is PLON: *Projekt Leerpakket Ontwikkeling Natuurkunde* (Physics Curriculum Development Project).

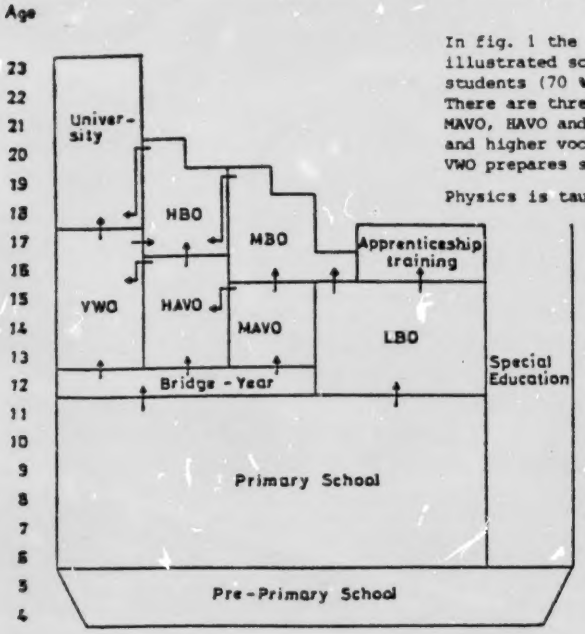
1.2 address

The project has been accommodated in the premises of the *Teacher Training and Educational Research Group* of the Physics Department of the *State University of Utrecht*.
Correspondence should be addressed to:
PLON
Lab. Vaste Stof
Princetonplein 1
Postbus 80.008
3508 TA Utrecht
The Netherlands.
Our telephone number: 030-532717

1.3 general purpose of the project

The general purpose of the project is to modernize and update physics teaching and the physics curriculum in secondary schools. The materials being developed are for use with pupils aged 12-18 at schools providing tuition at the following levels:

- intermediate general (MAVO);
- higher general (HAVO);
- pre-university (VWO).



In fig. 1 the organisation of education in the Netherlands is illustrated schematically. After leaving primary school, most students (70 %) enter a kind of general secondary education. There are three kinds of school for general secondary education: MAVO, HAVO and VWO. The first two prepare students for intermediate and higher vocational or technical education (MBO and HBO). The VWO prepares students for university entrance.

Physics is taught from form 2 onwards (age 13 and up).

Fig. 1
The educational system in the Netherlands.

VWO	pre-university education
MAVO/HAVO	intermediate and higher general secondary education
LBO/MBO/HBO	technical and vocational training

The arrows refer to the possibilities to continue one's studies at a higher educational institution

The project is concerned with developing and evaluating new teaching materials and methods, and training teachers to use these effectively.
For more specific objectives, see section 2.

1.4 staff

The staff of PLON and their special responsibilities are:

project coordination	Harrie Eykelhof
	Koos Kortland
MAVO and HAVO/VWO-lower forms	Ton v.d. Valk (coordinator)
	Koos Kortland
	Pieter Hogenbirk
HAVO-higher forms	Frits Gravenberch (coordinator)
	Harrie Eykelhof
	Hans Vermeulen
	Pieter Hogenbirk
	Bruce Pelupessy
	Koos Kortland
	Piet Lijnse[1]
	Dick v. Genderen[1]
VWO-higher forms[2]	Frits Gravenberch
	Ton v.d. Valk
research and evaluation	Ronny Wierstra
	Ton Jurg
technical staff	Wim Kamphuis
	Ad van Gameren
secretariate	Gatha Schwering
	Bianca Schillert-Holvast

All the staff were physics teachers before joining the project and some of them still are (on a part-time basis). Research and evaluation-staff are psychologists, with a special interest in instructional psychology and curriculum-evaluation.

1.5 organisation

Project activities are spread over four main fields:

- curriculum development;
- teacher training and participation;
- research and evaluation;
- dissemination and innovation.

The four fields are described separately in sections 3, 4, 5 and 6. It should be emphasized that these four fields are closely linked and are strongly interdependent.

Although the team members have widely varying interests they are jointly responsible for project policy and management; there is no specially designated leader. Weekly discussions are held to plan and evaluate activities.

PLON is responsible to the *Advisory Committee for Curriculum Development in Physics* (ACLO-n). A special sub-committee of

[1] Members of the Teacher Training and Research Group of the Physics Department who participate in PLON on a regular part-time basis.

[2] Teaching materials for VWO-higher grades are being developed in cooperation with staff-members of the University of Amsterdam and the State University of Groningen, together with some fifteen physics teachers on a regular part-time basis.

ACLO-n - whose members represent teaching, teacher-training, policy and research - guides and controls the activities of PLON. The chairman of this sub-committee is Prof. Dr. H.P. Hooymayers.
Once a month there is a meeting with this special sub-committee of ACLO-n. At these meetings important policy decisions are taken with regard to the project as a whole.

1.6 finance

From the 1st of August 1972, till the 31st July 1973, the project was financed by the *Foundation for Educational Research* (SVO).
From the 1st of August 1973 up to the present the project has been financed by the *Ministry of Education*.
From the 1st of August 1979, part of the evaluation-studies are financed by the *Foundation for Educational Research*.
The participation of the *Teacher Training and Educational Research Group* of the Physics Department is financed by regular university funds.

2. educational aims of the project

Some of the basic educational principles of the project are as follows:

- Physics lessons must be interesting and meaningful to all pupils, whatever their interests and abilities.
  It is more important that lessons be based on the cognitive structure of pupil-experiences than that they link directly with the scientific structure of the subject matter.
- Physics should be linked to the every-day life of the pupils. In most cases, this means that the content is being learned in a context, drawn from the world pupils live in: water, air, automatic controls and safety-devices, home-heating, insulation, photography, traffic safety devices, etc.
  School physics should deal not only with scientific concepts and models but should contribute to a better understanding of the applications of such concepts and models in the field of science and technology.
- School physics should deal with the relation between physics and society, so that pupils get an insight in the possibilities and consequences physical knowledge has for society. This includes learning to form an opinion about the use of technology, scientific methods and physical knowledge in view of important social issues (such as the energy-problem, the nuclear arms race) and the political dicision-making connected.
- Lessons based on PLON materials should enable pupils with varying interests and abilities to be taught together in one class and should give pupils opportunities to make their own decisions about the way in which they work (about their style of work) and about some of the content learned (about 30 %);
- The lessons should encourage pupils to work wich each other as well as with their teachers. PLON materials should provide plenty of opportunities for this by involving pupils in experiments, demonstrations, planning-schemes for lessons, etc.

Special attention is paid to ways of tackling problems, in physics as well as in technology. Pupils are always expected to play an active part in lessons and to work with another; they are encouraged to discover their own abilities and interests.

3. curriculum development

3.1 development strategy

The general development procedure for constructing a teaching unit is as follows:

- *development of the first version*
  During the construction of the first version of a unit, a reflective dialogue between the course writers is organised to obtain a clearer picture of the unit criteria.
- *try-out some months later, together with the collection of evaluation data*
- *revision for the purpose of producing a second version*
  The construction of a second version is preceded by a fairly extensive revision debate. During this process we not only revise the materials, but we also reconsider and restate the unit criteria.
  During this process specific questions arise that lead to the choice of research and evaluation topics for the next try-out.
- *second try-out (one year after the first try-out)*
- *second revision, etc.*

Closely linked to the construction of a teaching unit is the teams task to clarify for the sake of the teachers the ideas underlying the unit, to write a teachers' guide and to introduce the unit to the trial teachers.

In the school-year 1975-1976 a first version for the second form was tried out in six MAVO-schools. In 1976-1977 a revised version of these course materials was used in four new schools as well as in the six original schools. In 1977-1978 new teachers have been guided in an experiment with a third (revised) version of second form materials.
Likewise, the course materials for other grades and other types of school have been and will be developed according to the model of stepwise curriculum development.

3.2 present state and future plans

At this moment the PLON-units for second and third form courses HAVO/VWO and the MAVO-course have been revised for the last time[1]. The production of teachers' guides and technicians' manuals for these units is almost completed.
PLON-units for fourth and fifth form HAVO are available in first version. Discussions on the revision of these units are taking place in 1982.
Hitherto some 50 schools are using PLON-materials on a more or less regular basis. In 1982 some 200 MAVO-pupils and some 200 HAVO-pupils will take a final examination specially developed for the PLON-course.

In the next years, attention will be given to:

- construction of a second and final version of course materials for fourth and fifth form HAVO;

[1] Units already produced are listed in section 7.

- construction of course materials for fourth, fifth and sixth form VWO;
- compilation of a PLON handbook;
- form, content and administration of the MAVO and HAVO final examination;
- general innovational activities in cooperation with *Regional Centres for Teacher Training* (NLO/ULO);
- diffusion and dissemination of course materials;
- cooperation with other institutes in connection with research on specific questions arising from the course.

4. teacher training and participation

We keep in very close touch with our trial schools, visit them regularly and observe lessons. These lessons are discussed afterwards. Our technicians also visit the schools to advise on apparatus and other facilities.
Regularly we organise preparation courses for teachers involved in the project. Some of these courses are carried out by *Regional Centres for Teacher Training* (NLO/ULO).
Several times a year we organise a conference, to which we invite teachers involved in the project. On some occasions we also invite school physics teachers who are interested in our project. During these meetings we discuss the experiences of teachers working with PLON-materials in their classes.

Some teachers also participate in various aspects of project activities.

PLON-materials provide teachers with guidelines for structuring and evaluating processes of learning and teaching physics. It aims to make teachers aware of the many problems connected with fitting the physics curriculum into the school as a whole as well as into the general organisational structure of the school.

5. research and evaluation

The research done by PLON is mainly planned, empirical research but not in a narrow sense; it includes the systematic investigation and interpretation of data relating to the classroom use of developed materials. PLON uses not only quantitative designs but also a system of explicit qualitative documentation of personal experiences, for example in the form of observation reports.
As evaluation instruments PLON uses questionnaires for teachers and pupils, affective measurements, achievement tests, classroom observation, pupil interviews, teachers' logbooks and expert judging (by physicists, adminstrators and experienced teachers). These data sources are directed on cognitive as well as on motivational aspects of learning and instruction.
Univariate and multivariate analysis is used both in the construction of evaluation instruments and in the final interpretation of data.
Some of the cognitive tests are constructed in cooperation with an external agency: *The Central Institute for the Development of Achievement Tests* (CITO).
The combined results of the various evaluation techniques provide evidence that permits decisions to be made with regard to the alteration and revision of materials.

Numerous sources of data are required because of the variety of topics to be evaluated and the variety of criteria used.
Although there are initially certain criteria which influence the nature and content of first-version units, some criteria do not emerge clearly until later, in the course of development of the evaluation process (progressive focussing approach).
The criteria are expressed not only in terms of learning outcomes (product-criteria) but also in terms of relatively autonomous process criteria such as those mentioned in section 2.

Although there is emphasis on evaluation, PLON research also covers:

- the gathering of general educational know-how by study and own research about instructional- and learning-processes that are central in PLON (individual differences, connections between the learning of physics and daily-life knowledge, etc.);
- meta-evaluation. This includes a careful description and analysis of PLON evaluation-strategy. A special SVO-grant has been provided for this work.

6. dissemination and innovation

The activities mentioned so far are all part of a general plan for innovation and dissemination.
Gradually more teachers are being invited to use the materials of the project and to discuss the various possibilities and difficulties as they encounter them. From these data a guidance and training programme for use in the implementation phase is being planned and developed.
It is not the intention that each school in the Netherlands should use PLON materials or the PLON-curriculum, but the programme aims at a gradual dissemination of PLON ideas in Dutch secondary education.
This programme is being supported by some fifteen *Information Centres for Physics Teaching*, established at the *Regional Centres for Teacher Training* (NLO/ULO) throughout the Netherlands.
These centres give information to interested physics teachers on teaching physics with PLON-materials.

7. materials produced

Materials still in the course of development are not on sale, but sample copies are available on request from PLON, Lab. Vaste Stof, Postbus 80.008, 3508 TA Utrecht, the Netherlands.
Materials in final version are on sale from: N.I.B.-educational Publisher, Postbus 144, 3700 AC Zeist, The Netherlands.

All units are in the form of a pupils' book, a teachers' guide and a technicians' manual. All course material is written in Dutch.

PLON units:

- A First Exploration in Physics
- Men and Metals
- Working with Water
- Living in Air
- Ice, Water, Steam

for second form MAVO, HAVO, VWO (13/14 years old)

- Bridges
- Seeing Movements
- Reproducing Sound
- Physics in Society: Water for Tanzania[1]
- Energy in our Homes
- Physics in Society: Energy in the Future[1]
- Electrical Networks
- Colour and Light

for third form MAVO, HAVO, VWO (14/15 years old)

- Traffic and Safety
- Physics in Society: Stop or Move on?[1]
- Heating and Insulating
- Switching and Controlling
- Machines and Energy
- Physics in Society: Nuclear Arms and/or Security[1]
- Forces[1]
- Review for final exam MAVO
- Question Book

for fourth form MAVO (15/16 years old) and third form HAVO/VWO (14/15 years old)

- Materials
- Traffic
- Electrical Machines
- Patterns of Sound
- Cycles
- Energy and Quality

for fourth form HAVO[1] (15/16 years old)

[1] Still in the course of development.

- Matter
- Electronics
- Sources for Light
- Radiation
- Review for final Exam HAVO

] for fifth form HAVO[1] (16/17 years old)

- Transport

] for fourth form VWO[1] (15/16 years old)

[1] Still in the course of development.